Behaviour in therapeutic medical care: evidence from general practitioners in Austria

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Subjects and methods Medical services, provided by 3919 general practitioners in Austria, were operationalized by means of the dependent variable "costs per patient". Statistical outliers were identified using Chebyshev's inequality and categorized by investigating bivariate correlations between the dependent variable and the personal characteristics of each physician.
Results Variables that relate to the size of the customer base, such as number of consultations (r = 0.385) and office days (r = 0.376), correlate positively with the costs for medical services.
By analyzing the portfolio of the general practitioners, we found a correlation of 0.451 between this co-efficient and the costs. Statistical outliers feature an average portfolio of 44.5 different services, compared to 30.45 among non-outliers. Especially laboratory services were identified as cost drivers (r = 0.408). Statistical outliers generate at least one laboratory parameter for 44.34% of their patients, opposed to 27.2 % within the rest of the sample. Consequently outliers produce higher laboratory costs than their counterparts.
Conclusion We found some evidence that physicians have influence in the provision of their services. Considering entrepreneurial objectives the extension of the portfolio can increase their profit. Our findings indicate supplier-induced demand for several groups of services. We assume that the effect is consolidated by the fee for service system and could be compensated by adequate reform.

Response to Reviewers: I uploaded a sideletter to the reviewer including the list of changes.

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Keywords

general practitioner, supplier-induced demand, therapeutic medical care

Abbreviations

supplier-induced demand (SID), general practitioner (GP), therapeutic medical services (TMS)

Introduction

In primary care, general practitioners (GPs) represent the first point of contact for people with illness issues, who determine the diagnosis and advise their clients regarding the adequate treatment (Statistik Austria 2006; Knox and Britt 2004; Smits et al. 2009). Because of their steering function in the health care system, GPs are often referred to as gatekeepers who regulate and control the demand for medical services (Toon 1994).

They decide whether the service of another colleague or discipline is inevitable or if their portfolio is sufficient enough to induce the recovery of the patient. The personal portfolio can basically be classified into the prescription of pharmaceuticals and the autonomous delivery of medical services, where the latter represents the doctor's income. As e.g. in Germany and Austria outpatient therapeutical medical care is financed by social insurance institutions and therefore consumers rarely control the generated quantities, health economists assume that doctors have the ability to create demand for their services (Peacock and Richardson 2007; Fuchs 1978). This phenomenon is referred to as supplier-induced demand (SID), which implies that the producer of medical services defines the degree of his capacity utilization according to his own preferences - including his salary requirements - without the basic market forces regulating the transaction (Richardson 2001; Freebairn 2001).

The model is based on a study by Evans (1974), who analyzed the financial situation of physicians in outpatient therapeutic medical care under the assumption that the income not only depends on the actual demand for medical services, but also on the providers' preferences. One of the most recognized publications in this field was presented by Fuchs in 1978. He reported direct association between the physician density per capita and the number of therapeutic medical services (TMS) performed. In his sample a 10% rise in surgeon positions increased the demand for surgeries by 3%. In absolute numbers each additional position in the particular region would imply an increase of between 40-60 surgeries per year (Fuchs 1978).

Other studies since the late 1970s have advanced the theoretical and empirical knowledge of SID, which in the USA is also referred to as physician-induced demand PID (Green 1978; Auster and Oaxaca 1981; Freebairn 2001). Most of the research refers to the fact that the personal income is an important determinant in the physician's utility function and a shift in doctor's advice to more expensive medical treatment can be autonomously induced by the providers.

However, the monetary effect of SID was discussed by Stano, who assumes that SID could only occur in monopolistic markets, since the effect can never compensate for the loss in earnings if the market is saturated (Stano 1987).

There is a controversial debate on the view if SID is a phenomenon of self-interest of the physicians, emphasizing the doctor's role as an agent who has to preserve the patient's interests (Rossiter and Wilensky 1984). In this context the dual capacity of the GPs causes some reason for doubt. On the one hand they represent trusted advisers in health matters of their clients, but on the other hand they operate as entrepreneurs who can benefit from excessive supply (Breyer and Zweifel 2004). This antagonism is enhanced by the information asymmetry between the protagonists, with the less informed patients delegating health care desicions to the doctors. This behaviour remains unproblematic as long as the latter serve as perfect agents, without pursuing opportunistic interests.

Based on the present state of research in the field of SID and under the assumption that physicians who operate in a social health care system have to economize when choosing the adequate treatment for their patients, the main objective of the present study is to analyze the behaviour in outpatient therapeutic medical care.

According to the above-discussed literature, the aim of the present study is to answer the question if *GPs providing excessive medical services can be identified.* It will be evaluated to what extent miscellaneous individual characteristics of physicians have an impact on their behaviour by using the example of Austrian GPs and the medical services they generated during the year of 2008.

Methodology

The present study uses data from an national social insurance institution from 3,919 GPs nationwide in the year 2008. The cooperating institution represents the social insurance company for the self-employed in Austria, with a customer base of 461,301

insurants. In Austria approximately 6,400 GPs work in private practice, with 4,367 GPs being under contract with the cooperating social insurance institution.[1] The dataset only includes doctors who provide medical attendance during the entire year, excluding those who went out of business or started operations during that period. During the observation period 2,903,820 consultations were conducted that accounted for € 59,477,598.

After the selection of the outliers their personal characteristics are to be detected. The objectives require the identification of all statistical outliers in the following category, which also represents the dependent variable (DV):

DV = Total expenditure per patient for TMS provided

In calculating the outliers, we take into account that there is a strong linear relationship between the costs for medical services and the number of patients treated. The graph which describes the relationship runs through the zero point and has an inclination that represents the proportionality constant. The proportionality constant equates to the average costs per TMS, calculated over the total sample of 3,919 GPs.

b = total costs / total number of patients

With the proportionality constant the estimated costs for each GP are calculated by the formula:

estimated costs = b * number of patients

We use the distribution of the deviations of the actual costs per patient from the estimated costs to define a statistical outlier:

> *An outlier is a physician, whose discrepancy between actual and estimated costs for medical services exceeds the 90 % percentile of the distribution of the discrepancies of all physicians with the same number of patients.*

To determine the limit that has to be exceeded in order to be identified as an statistical outlier we apply Chebyshev's inequality, which reads as follows (Fisz 1971):

[1] Standesmeldung Österr. Ärztekammer, Juni 2010

If X is a random variable X with a second order finite moment $E(X^2) < \infty$, then for every constant c>0 holds: $P(|X| \geq c) \leq E(X^2) / c^2$. In our case X represents the deviation of the actual costs from the estimated costs.

+++insert figure 1+++

Fig. 1 Chebyshev's inequality

This inequality has the advantage to be a very conservative method to determine outliers, since it only identifies outliers whose actual costs deviate dramatically from the estimated cost. Moreover no estimation for the special kind of the distribution (e.g. normal distribution) is needed for the calculation, since the method only requires an estimation for the second order finite moment of the distribution, which can be calculated from the empirical data. After determination of the numerical value of $P(|X| \geq c)$ the inequality can be resolved to c.

Typology of the outliers

In the attempt to categorize outliers according to their behaviour in therapeutic medical care we investigate bivariate correlations between the statistical outliers and the following independent variables:

a. Regional population
b. Physician density – number of GPs per community
c. Gender of the physician
d. Age of the physician
e. Dimensions of the medical practice measured by the patient frequency (office days, number of consultations)
f. Number of medical services
g. Portfolio of medical services
h. Quantity of services and costs in the field of laboratory medicine

These tested variables have no obvious relationship with the health status of the physician’s patients.

Results

The primary focus of this study is to evaluate the role of the GP in the demand for medical services by statistically analyzing his behaviour irrespective of the patient's health status. Table 1 presents an overview of the correlation between the relevant variables. The strong correlation between the patient quantity and the costs (r=.71) confirms our decision to use the average costs per patient as the dependent variable to identify statistical outliers.

+++insert table 1+++

Table 1 Overview of the relevant variables

Within the sample a total of 437,532 patients were treated, who consulted their GPs 2,903,820 times during the year 2008 and received a total number of 6,576,830 services, which amounted to € 59,477,598. Based on the numerical value per patient (€ 135.94), the anticipated cost for each physician and the deviation from the actual costs can be calculated. The application of Chebyshev's inequality shows a significant deviation from the estimate in 148 cases. In other words, the treatment expenses of 148 GPs, measured by the deviation of the actual costs per patient from the estimated costs, exceed the rest of the sample significantly. In this subsample of 148 statistical outliers the total sum of costs above the extimated costs amounts to € 2,238,777.90.

Now we intend to contain the statistical outliers by explaining their behaviour in therapeutic medical care with criteria or a combination of criteria that are characteristic for the physician.

We found correlations between the dependent variable (costs per patient) and all variables that relate to the patient frequency (office days, number of consultations). The correlations vary between 0.376 (office days) and 0.385 (consultations). This indicates that the doctor's income is dependent on the size of his customer base and the magnitude of the demand for his services. That assumption is confirmed by the

following findings: Outliers have significantly more office days and a larger number of consultations than subjects that do not exhibit these attributes (Tab. 2).

+++insert table 2+++

Table 2 Office Days

+++insert table 3+++

Table 3 Consultations

The probability that an outlier is identified within group 2 is nine times higher that within the group with less capacity. In this and all following contingency tables “group 2” contains the physicians whose value in the independent variable exceeds the upper limit of the so-called 2-sigma-range. Group 1 contains the rest of the sample.

Between the criterion ”population“ and the dependent variable we found a negative correlation of -0.241, indicating that physicians who produce more quantity are likely to be located in regions with a smaller population. Additionally, we compare physicians from the two biggest municipal regions (Vienna and Graz) with the rest of the sample (Tab 3).

+++insert table 4+++

Table 4 Population

As expected we found significantly more outliers outside the two municipal areas. The probability to identify an outlier in a rural region is twice as high as finding one in a municipal area. In contrast the physician density, which represents a common feature of many SID studies, could not be detected as a variable of relevant influence within the sample.

When analyzing the quantity of medical services, the data provides evidence for an appreciable correlation between the number of medical services produced by the physician and the costs ($r = 0.425$). The outliers show an average of 2098.39 therapeutic services annually, compared to 1131.09 services for the rest of the sample. The dichotomous analysis verifies the results, since the group of physicians

that produces more quantity contains 7 times more outliers than the other group (Tab 4).

+++insert table 5+++

Table 5 Number of services

Considering the fee structure for medical services, the findings seem to be trivial, since prices are fixed and basically the quantity regulates the costs. However, we decided to assess the subject more extensively by focusing on the physicians' individual portfolio. In this context we define the GP's portfolio as the range of medical services, measured by the number of different services according to the current fee structure. The correlation between the dependent variable and the criterion "portfolio" is 0.451. The mean comparison indicates that outliers (44.51 different services) have a greater portfolio than their peers (30.45 different services). The dichotomous analysis is highly significant and supports the results (Tab 8).

+++insert table 6+++

Table 6 Portfolio

We continued by investigating if a group of services might induce this trend exceptionally and found a positive correlation (r = 0.408) between the number of laboratory services and the dependent variable.
On average statistical outliers provide 433.96 laboratory services compared to 148.32 services by their peers. The evaluation of the laboratory costs featured a corresponding result (Tab. 6, 7).

+++insert table 7+++

Table 7 Number of laboratory services

+++insert table 8+++

Table 8 Costs of laboratory services

Finally we focused on the criterion "laboratory services" to investigate possible differences between the statistical outliers and non-outliers in this area:

The mean value of the annual costs for laboratory services per physician within the group of outliers is € 4,013.46 (standard deviation 3,516) compared to € 1,453,20 (standard deviation 1,834.27) with non-outliers. The costs for laboratory services per patient reveal a similar result. In the group of outliers the annual costs per patient average € 90.75 (standard deviation 57.64) compared to € 40.21 (standard deviation 34.28) with non outliers.

+++insert table 9+++

Table 9 Key data for laboratory services

The laboratory quota represents the percentage of patients who receive a laboratory test during the consultation of their GP. Outliers perform at least one or more tests per year for 44.34% (standard deviation 14.13%) of their patients, opposed to 27.82% (standard deviation 11.68%) among their counterparts. Since every laboratory parameter contributes to the GP's income we calculated the share of laboratory revenue of the total revenue. The percentage of the physician's income that can be attributed directly to laboratory services is on average 14.24% (standard deviation 9.31%) in the group of outliers and 9.16% (standard deviation 12.08%) amongst other providers.

Considering the final two criteria of our study, neither the variable age of the physician nor gender had a significant influence on the costs per patient.

Discussion

In Austria, outpatient therapeutic medical care is disbursed on a “fee for service” basis (§ 28 Honorarordung). With the exception of a few capped positions, the doctor’s income correlates positively with the number of services provided for his clients and consequently with the number of consultations. This type of remuneration system does not use the medical output in terms of “production of health” to determine the net income of the provider. Therefore, an economical and considerate use of the resources is not necessarily required. Through its monetary incentives the modality of payment for medical attendance determines not only the costs of health care but also the effectiveness of the system. In general, effectiveness can be described by the capability of the selected procedure to achieve the objective – in our case the recovery of the patient.

Accordingly, GPs are expected to (Devlin and Sarma 2008; Newhouse 1996):

- supply as many patients as possible with TMS and to be continuously available for their clients
- offer a wide range of medical services to meet the individual requirements of their patients
- establish a personal doctor-patient relationship with all customers without discriminating against high-risk groups

The “fee for service” system meets these requirements (Rice 1997; Devlin and Sarma 2008). Physicians who provide a sizable clientele with a maximum of services are rewarded, sanctioning those who accomplish less quantity (Robinson 2001). Our study supports the assumption that the size of the customer base and the frequency they demand for doctor’s advice is the biggest cost driver in therapeutic medical care. The findings are comprehensible and inherent to the current remuneration system. In this context a few drawbacks of the fee for service approach should be mentioned: Neither the adequacy of the supplied services nor the enhancement of the population’s health status represent criteria for success (Hickson et al. 1987). Also interdisciplinary collaboration between the different groups of health care professionals is not promoted. Most of these shortfalls could be balanced by implementing alternative remuneration mechanisms such as “pay for perfomance” or “capitation”, which presently are not established in the Austrian health care system (Levaggi and Rochaix 2003).

Under the assumption that the behaviour of GPs in therapeutic medical care is also determined by personal requirements of the care provider, the theory of SID becomes a popular research area for health economics. As stated above, to be considered an inducement, the medical services should be of questionable value to the patient and primarily initiated for profit and not medical reasons (Bradford and Martin 1995). Eventually there also is a strong coherence between the system of remuneration for medical services and the likelihood of SID. Physicians who derive their income in a ”fee for service“ system have a 30% higher probability to initiate further consultations than their peers in ”capitation“ or ”pay for performance“ settings (Phelps 1997). The interdependency between SID and health care costs appears to be reasonable, since our current system measures the GP’s income in achieved quantities, whereas alternative approaches emphasize the outcome of the medical intervention. Against this background the steering function of the remuneration system becomes apparent.

The results of our study provide some insight into the GP’s latitude when providing medical treatment. The tendency that physicians with extensive portfolios frequently exceed the costs indicates the occurence of SID within the sample. Statistical outliers feature on average 14 more services within their portfolio than physicians with a more economic behaviour. We assume that most of the effect can be attributed to the possibility to provide laboratory services. Considering the average laboratory costs per patient, the identified statistical outliers exceed the rest of the sample by 125%. Also the mean laboratory quota of 44.34% within the outlier group appears to be rather excessive, especially if you consider the GP to be more of a generalist and not necessarily a specialist for laboratory diagnostics. It is highly improbable that the disparities in the magnitude of conducted laboratory services can exclusively be attributed to the health status or active demand on behalf of the patients. Rather the qualification of the physician - and his opportunity to allocate activities - increases the supply. Consequently if a physician is permitted to procure a certain product range, he is capable of providing TMS irrespective of the actual demand.

Our findings indicate the existence of SID – not necessarily for the occupational group collectively, not even for the individual GP’s full range of services, but more probably for several types of services. It seems appropiate that, especially in the field

of laboratory medicine, tests can be generated by the bulk using technical equipment without exceptionally affecting the scarce time resources of the physician. Considering the entrepreneurial objectives in a fee for service system, the expansion of the portfolio of TMS seems to be a common method to increase profit (Carrin and Van Dael 1984). The effect is however consolidated by the prevailing system of remuneration and could be absorbed by adequate reform. Reflecting the opening statement about the GP's core competences and his particular importance to the health care system, alternative forms of payment that inhibit SID by compensating the GP ad valorem are inevitable.

The following limitations of this study should be mentioned:
The behaviour of the GPs was analyzed based on the available data. Since only the billing data of the national health insurance was accessible, the diagnoses of the patients and the form of therapy could not be evaluated. Therefore the study was conducted without consideration of the clients' health status. Another critical point is the absent comprehensive survey reflecting on the interdependency between the medical services and the pharmaceuticals prescribed by the physicians. We assume that these factors are mutually dependent and would like to focus on that assumption in a follow-up study.

Conflict of interest

The authors declare that they hove no conflict of interest.

Acknowledgments

The authors would like to express their appreciation to the SVA der gewerblichen Wirtschaft for providing us with the data used in the study.

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	patient quantity	office days	consultations	medical services quantity	medical services costs	laboratory services costs
patient quantity		.61	.86	.79	.71	.50
office days	.61		.72	.69	.61	.43
consultations	.86	.72		.95	.84	.65
medical services quantity	.79	.69	.95		.86	.81
medical services costs	.71	.61	.84	.86		.66
laboratory services costs	.50	.43	.65	.81	.66	

Table 1 Overview of the relevant variables

	non outliers	outliers	total
group 1	3732	130	3862
group 2	39	18	57
total	3771	148	3919
chi square	123.04		
mean	175.63	209.92	

Table 2 Office Days

	non-outliers	outliers	total
group 1	3636	127	3763
group 2	135	21	156
total	3771	148	3919
chi square	41.94		
mean	536.54	882.22	

Table 3 Consultations

	non-outliers	outliers	total		non-outliers	outliers	total
Vienna	631	12	643	Vienna/Graz	770	15	765
rest	3410	136	3276	rest	3021	133	3154
total	3771	148	0	total	3771	148	3919
chi square	Jul 72			chi square	Aug 62		

Table 4 Population

	non-outliers	outliers	total
group 1	3633	110	3743
group 2	138	38	176
total	3771	148	3919
chi square	160.93		
mean	1131.09	2098.39	

Table 5 Number of services

	non-outliers	outliers	total
group 1	3668	130	3798
group 2	103	18	121
total	3771	148	3919
chi square	42.33		
mean	30.45	44.51	

Table 6 Portfolio

	non-outliers	outliers	total
group 1	3633	110	3743
group 2	138	38	176
total	3771	148	3919
chi square	160.93		
mean	148.32	433.96	

Table 7 Number of laboratory services

	non-outliers	outliers	total
group 1	3629	110	3739
group 2	142	38	180
total	3771	148	3919
chi square	156.01		
mean	827.43	2434.46	

Table 8 Costs of laboratory services

	outliers		non outliers	
	mean	standard deviation	mean	standard deviation
total laboratory costs	4,013.46	3,516.00	1,453.20	1,834.27
total laboratory services	707.53	602.47	259.87	325.56
laboratory costs per patient	90.75	57.64	40.21	34.28
laboratory quota	44.34%	14.13%	27.82%	11.68%
income quota	14.24%	9.31%	9.16%	12.08%

Table 9 Key data for laboratory services

Figure 1

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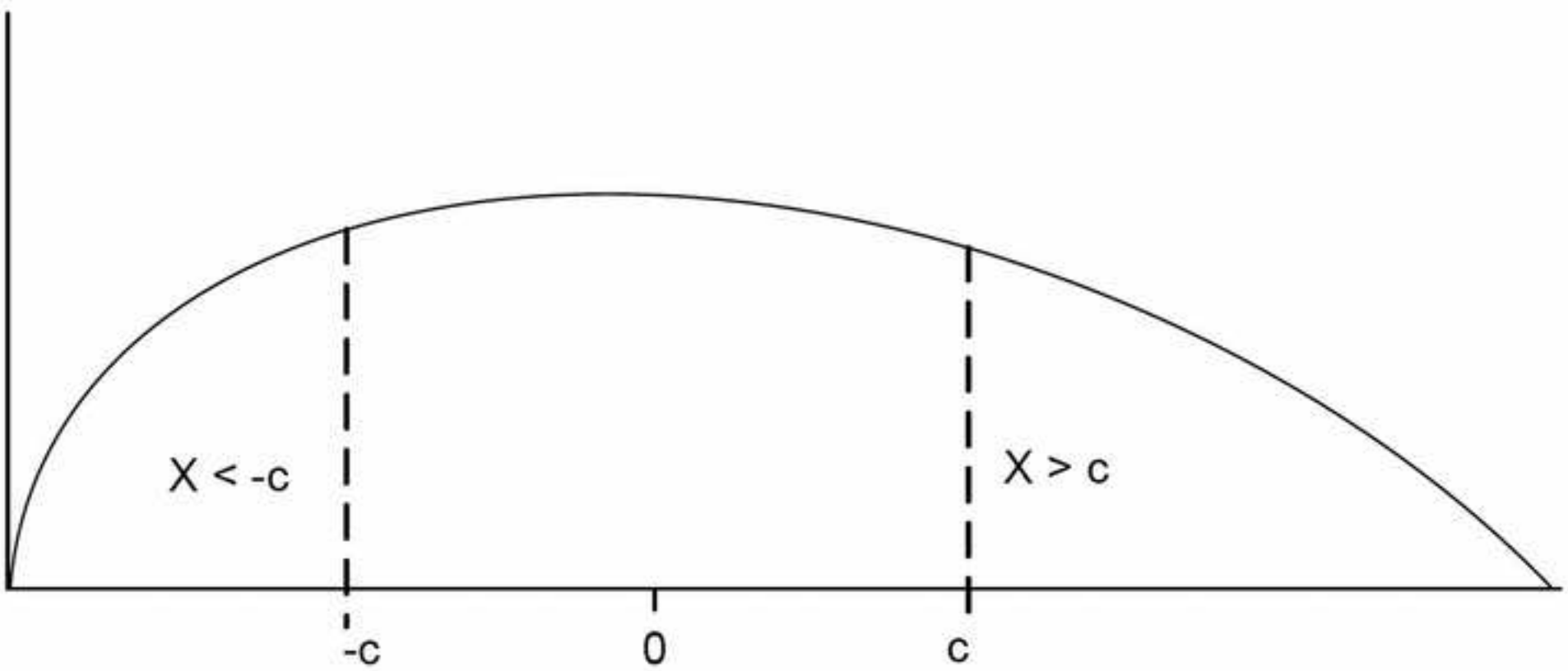

List of changes

1. *Abstract: Should be shorter and focused on main contents/messages (150-250 words)*
    - Revision p.1: The number of words was reduced from 362 to 247

2. *Question: From the context of the manuscript it is not comprehensible if the number 3919 general practitioners is to be covered to Austria in total*
    - Revision p.3 last break: The present study uses data from an Austrian national health insurance institution from 3919 GPs nationwide in the year 2008. In Austria approximately 6400 GPs work in private practice, with 4367 GPs being under contract with the social insurance institution. Physicians who did not provide services for the cooperating social insurance institution during the entire year of 2008 were excluded from the sample.

3. Page 2 (Introduction), I.3: In Germany, medical services are predominantly paid by social insurance institutions but there are other resources like private health insurances and others. In fact, remuneration by private health insurances constitutes a very important source of income for GPs.
    - Author's comment: The study does not include privately financed services of GPs. Within the group of GPs, who are under contract of a social insurance company, the vast majority of services are financed by the social insurance institutions. To some extent legal restrictions even prohibit this group of physicians to invoice private bills.
      In contrast within the group of GPs who are not under contract of a social insurance institution (Wahlärzte) all medical services are paid on the patient's own account – and only if the patient files the invoice to his social insurance company, they reimburse 80% of the costs. However this group of GPs is not included in the sample.
      The financing of GP services through private insurance institutions is not a common method of remuneration on the Austrian market, since they predominantly focus on financing hospital services.
4. Page 3, I.53: Maybe better: "It will be evaluated to what extent…"
    - Revision p.3: was adopted in the text
5. Page 4, I.12/13: Sentence "According to the above-questioned literature, the aim…" fits better on page 3 between I.51 and 52/53
    - Revision p.3: was adopted in the text
6. Question: Page 4, I.2: What kind of health insurance institution cooperated with you in order to conduct the study? In Germany, different health insurances exist with more or less different groups of insured people (differ for instance in age, socio-economic status, chronic diseases…)
    - Revision p.3/4: The cooperating institution represents the social insurance company for the self-employed, with a customer base of 461,301 insurants.
7. Acknowledgment
    - Revision p. 12: The authors would like to express their appreciation to the SVA der gewerblichen Wirtschaft for providing us with the data used in the study.